METHOD FOR MAKING MECHANICAL PARTS BY DECOMPOSITION INTO LAYERS

The subject of the present invention is an improvement to methods for producing mechanical parts and objects, particularly prototypes, from a specific computer-aided design of the type comprising the successive phases of:

- manufacturing parts in elemental layers or laminations;
- building up the collection of layers;
- assembling the layers;

said laminations resulting from a prior breakdown of the part along planes and one or more defined steps.

The invention is also aimed at the elemental laminations thus produced, and at the prototypes obtained by assembling said elemental laminations.

A rapid prototyping method of this type was the subject of European Patent EP-0 585 502-B1, the content of which is incorporated herein entirely by way of reference and is known by the name STRATOCONCEPTION (registered trade mark).

This method is entirely satisfactory within the limits of the applications specified in that patent, the various laminations essentially being positioned and assembled using inserts, the shape and position of which are determined also by specific software.

The fact of providing inserts on the inside, in the case of parts of a certain thickness, nonetheless makes the implementation process, which in other respects is very flexible and effective, somewhat cumbersome.

Furthermore, it is not possible easily to provide inserts on the inside in the case of laminations whose working

cross section (thickness of the final part) is small, which laminations are needed for obtaining very fine, and therefore more precise, modeling, or for producing parts whose complex structure entails a breakdown passing through laminations of very small lateral thickness.

The object of the invention is to propose a method according to the general concept of patent 0 585 502 that also makes it possible if required not to use inserts for the internal assembly of the laminations to each other and their positioning with respect to each other.

According to the invention, this result is obtained with a method for producing mechanical parts and objects, particularly prototypes, from a specific computer-aided design of the type comprising the successive phases of:

- manufacturing parts in elemental layers or laminations;
- building up the collection of layers;
- assembling the layers;

said laminations resulting from a prior breakdown of the part along planes and one or more defined steps, characterized in that the unitary laminations determined by the breakdown of the part employing software and machined accordingly, essentially comprise:

- a central portion effectively corresponding to the lamination with the desired shape and desired thickness for obtaining the finished part,
- an outer portion of roughly the same thickness, at least partially surrounding said central portion,
- frangible bridges connecting said central and outer portions together.

The laminations are then put together either by superposition or by shoring up the various laminations, the outer portions of each lamination finally forming a kind of supporting surround enclosing the reconstructed part to which it is connected by the frangible bridges.

It will be understood that the part is broken down and

assembled systematically through the use of the specific software which automatically positions and provides the bridges, the posts, the inner or outer inserts.

Thus, positioning and holding inserts are added to the outer surround. These inserts allow the laminations to be positioned indirectly by mounting and assembly (for example, but without implying any limitation, by bonding).

The supporting surround is then easily removed, because of the frangible bridges, once the laminations have been positioned and assembled.

The surround will enclose the final part from the smallest distance, for reasons of precision of assembly and economy of material, which in all instances will necessitate pressing by clamping.

The pressing system may be external, for example with a mount plate, or in-built, the surround being self-supporting.

The invention will be better understood with the aid of the description given hereinafter with reference to the appended drawings, in which:

- figure 1 illustrates schematically in the form of a diagram the principle of implementation of the method known as stratoconception;
- figure 2 illustrates schematically a part reconstructed from elemental laminations with an outer surround, according to the invention;
- figures 3A to 3F depict alternative forms of the frangible bridges and of the outer surrounds;
- figure 4 depicts the part of figure 2 with a self-supporting holding and assembly structure;
- figure 5 depicts an alternative form of the part of figure 2 with a holding and assembly structure that involves a mount plate;
- figures 6 and 7 depict an alternative form of the

part of figure 2, with an alternative form of assembly of the same type as that of figures 2 and 5;

- figure 8 illustrates, in part section, one possibly assembly with external inserts for complex shapes and thin laminations.

Reference is made first of all to figure 1.

The general principle consists, by using specific software (1), in cutting a part that is to be prototyped into laminations, the laminations being machined by rapid micromachining (2), the machine being controlled by the software (1), from a material (3) in sheet form.

The various laminations are assembled into a collection (4) comprising inserts (5) to finally obtain a prototype (6) after finishing.

The software governs the choice of slicing/stratification plane, of lamination profile step, of scale ratio, of precision and of the position of the inserts.

Once the various sheet parameters (dimensions, material, choice of direction of clearance) and the machining parameters (cutting rate, cutter diameter, etc) have been input, the entire machining program is transmitted by the software which controls the cutting robot.

Reference will now be made to figure 2.

According to the invention, the method implemented makes it possible to obtain a multitude of elemental laminations (7) which, once assembled, reproduce the part to be reproduced (8) connected to an outer surround (9) by bridges (10).

It will be understood that, following appropriate assembly, the elimination of the surround and of the bridges results in the obtaining of the final part (8),

particularly the prototype.

The laminations (7) may have different and highly varied geometric shapes at the bridges (10) and elements (11) that finally form the outer surround (9).

Various alternative forms are depicted non-limitingly in figures 3A to 3F.

Figure 3A depicts three alternative forms of bridges at the zone of weakness (12) where cutting will occur.

In figure 3B, it will be noted that the distribution of the bridges, for example three of these, may be uniform around the periphery of the central portion (in this particular instance at 120°).

In figure 3C, the alternative form consists in the elements (11) being rounded and enveloping sectors (13).

In figure 3D, three sectors such as (13) are joined together to form a single collar (14) which fully surrounds the part in a ring (15) in the depiction of figure 3E.

Finally, in figure 3F, the orifices (16') present in each structure and used to position and to assemble the bridges together, will no longer be circular (16) as they were in the previous figures, but will have a polygonal geometric cross section, which will allow their number in one and the same lamination to be limited, for the same precise positioning.

The laminations are assembled on shafts (17) of which, in figure 4, there are three, these for example, but non-limitingly, having wing nuts (18) for clamping. In this instance, the structure is self-supporting.

In figure 5, there are two shafts (21) fixed on a mount plate (19) equipped with bores (20).

This type of assembly may also be used when the method is implemented systematically and, for example, for teaching or even recreational purposes.

In figures 6 and 7, the structures are identical to those of figures 4 and 5, with just one shaft such as (17, 21) and one rod (22) of the insert type to provide positioning.

Finally, figure 8 depicts a complex alternative form with inserts (23) for extremely thin laminations, each insert involving just a few contiguous laminations.

Of course, each elemental lamination will be machined by micromachining in accordance with the general method known as “Stratoconception”, possibly with turning over, if necessary, in the course of machining, according to the method described in a patent application filed simultaneously by the applicant and to which express reference is made.

This method allows the manufacture of prototypes of parts of very complex shapes, very rapidly and at low cost. It also opens interesting opportunities for teaching and recreational applications.